MAN5 : MULTIVENDOR NETWORK MANAGEMENT SYSTEM

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ABSTRACT

Network users, faced with expansion and changing requirements, have been led to install networks based on different concepts and different technologies. Numerous communications situations exist where networks as varied as those of BULL, CDC, DEC, HP (X'25') and IBM are all found together (about 400 sites in Europe).

The users must then work with several networks each with its own management system. So, the different networks are managed separately and autonomously. The problems of administration caused by this type of multi-vendor or heterogeneous set-up, give rise to a partial view, in each separate network, of the activity of the heterogeneous communications system, especially for inter-network sessions.

MAN5, a management system for multi-vendor networks, is the solution to the problems specific to this type of set up. It takes the shape of software located at a host node of the heterogeneous network, communicating with the managers built into each element to receive the administrative information necessary and restitute the syntheses resulting from its activity.

CONTENTS

THE ENVIRONMENT OF MANS

1) MANAGEMENT DISTRIBUTION

Multi-vendor network management, if it is to be realistic, cannot dismiss the existence of the vendor's managers which have the advantage of already being operational and whose performance is constantly being improved. MANS is designed around these assets. In the following section we define the principles which must be used to guide the design of such a system and we establish its role in multi-vendor networks.

Analysis of any system of communication in a heterogeneous context shows :

- that the resources can be divided into those belonging to each system and those for interconnection situated at the boundary between the systems.

- that the overall activity can be divided into an internal activity, represented by intra-network communications and an inter-system activity i.e. inter-network communications.

For the resources belonging to each system and the intra-network communications, termed the intra domain, the vendor's administrators have total vision. The administration of the intra domain is entirely their responsability.

The interconnection and inter-network communication resources belong to the interconnection domain which is not managed by the vendor's systems. The role of heterogeneous network administration is precisely the management and control of this domain. So, our approach allows us to establish 2 hierarchical levels of management activity :

- local administration for which the vendor's systems are responsable,
- an overall administration limited to the interconnection domain.

The system which we propose has the advantage of using a single representation into which the administrative information of different networks are translated. The advantage of this unification is, in addition, to make the view of the interconnection resources homogeneous.

The distinction made between intra and inter-network activity and also between intra and interconnection resources does not imply that they are completely independent. The failure of an intra-network resource can

effectively be the cause of inter-network communication breakdown.

So, an administration system in a heterogeneous context is, of course, limited to the management and control of the inter-network domain but must also take into account the intra-network activity. The vision that the system must have of intra-network activity is limited to anomalies lethal in nature.

We can therefore define 2 levels of vision :
- vision which we call "macroscopic' of the intra-network domain,
- detailed vision ("microscopic") of the inter-network domain.

2) INTER-NETWORK TOPOLOGY

The data required by MAN5 to administer the heterogeneous system concern the interconnection topology and inter-network activity. Each network composing the multi-vendor communications system is described in MAN5's data base as well as configurations of interconnection with adjacent networks which can have four types of implementation :

- the gateway function is located on a boundary node.
- the gateway function is located on an intra-network node.
- the gateway function is located on both a boundary node and an intra-network node i.e. there is a distribution of the layers, with reference to the OSI model, on two nodes (lowers layers 1, 2 and 3 on the boundary node and the higher layers 4 and above on the intra-network node).
- the gateway function is on the two boundary nodes interconnecting the two networks (half gateway).

Thus, the logic interconnection configurations differ according to the implementation of the gateway function. For the physical resources considered to be part of an interconnection configuration (see fig. 1), only those in a particular geographic position between two networks are taken into consideration.

- boundary node with or without a gateway function,
- adjacent nodes in the connected networks,
- the interconnection lines (direct line between interconnection nodes or link to a public network : line which is rented, switched or x'25' circuit).

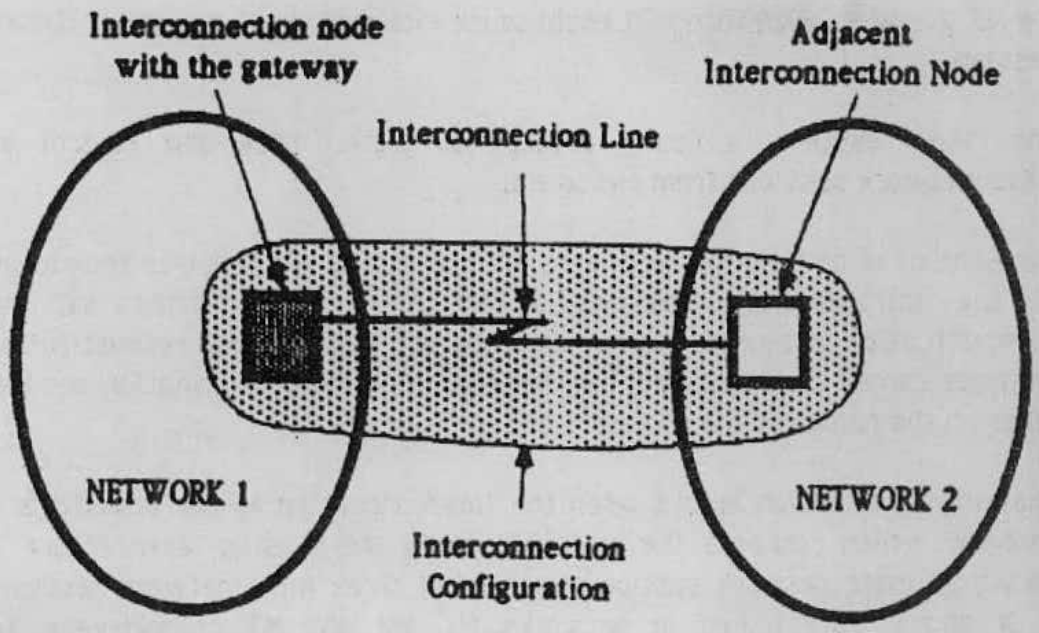

figure 1 : interconnection elements

3) THE INTER-NETWORK SESSION

An inter-network communication is composed of a connection established between two users belonging to two separate networks. An inter-network session can, according to the network, be composed of intra-network connection of different OSI levels. For example, in the configuration where a private X'25' network is connected to a DSA (BULL - Distributed Systems Architecture) type network, the resulting inter-network session will be composed of a level 3 (VC) connection and a level 5 (session) connection.

We mentioned that the manager of a vendor network has complete vision of intra-network sessions but only partial vision of inter-network sessions. This absence of full vision implies that the activity of part of the resources dealing with inter-network sessions is unknown to the operator.

For example, from the operator's terminal in network N3 (Fig. 2) only the activity of the resources of the same network is visible. That of the networks N2 and N1 is reported to their respective terminals. Morever, an inter-network session is seen by an operator in the same way as an intra-network session i.e. they are represented by identical administrative messages.

So, an anomaly occurring in network N2 or N1 remains undetected by

the N3 operator, even though it could cause interruption of an inter-network session.

The MAN5 system is really devoted to surveillance and control of inter-network sessions from end to end.

The control of an inter-network session from end to end requires knowledge of the intra-network sessions of which it is composed and the communication resources on which they are based. Two reconstitution methods can be distinguished, one depends on chaining information and the other on the names of the end users and their locations.

Chaining information exists when the interconnection is performed via a gateway which connects the protocols up to the session layer. Figure 2 shows an inter-network session composed of three intra-network sessions Y, X and Z established in networks N1, N2 and N3 respectively. To reconstitute the complete session it must be known that session Y is prolonged into network N2 by session X which is itself prolonged by session Z into N3.

The second methode applies in configurations where the interconnected networks are identical : e.g. two networks made by the same vendors or from different vendors but both conforming to the OSI model.

The inter-network session resulting from this interconnection is fully visible by both networks i.e. in each management system a massage represents the session from end to end.

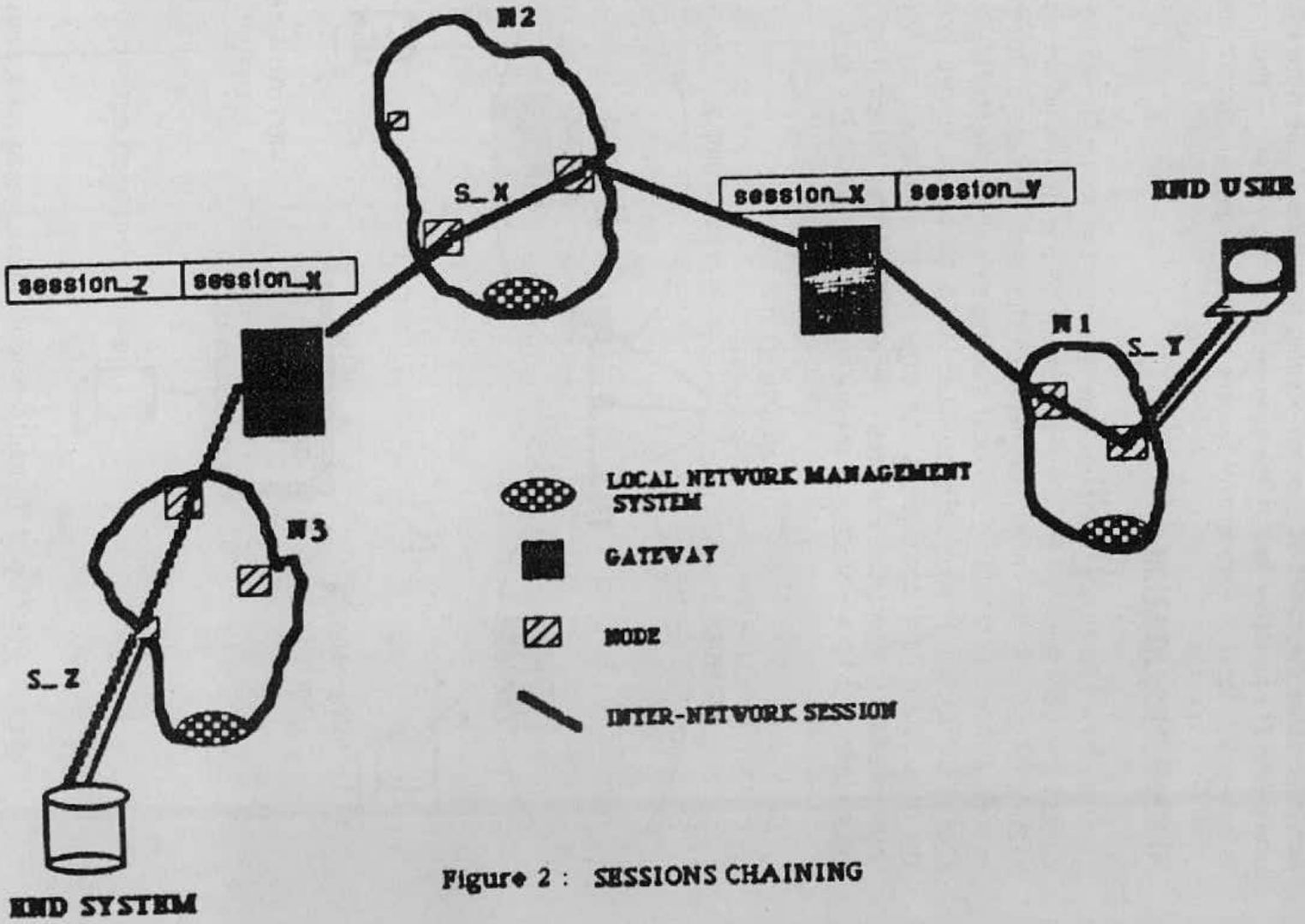

Figure 2 : SESSIONS CHAINING

The reconstitution process can be summarised as correlating the administrative messages of session opening by means of the names of the users who are at either end of the session connection. Clearly, this method is only practicable in environments where there is a pool of users' names.

4) MAN5 IMPLANTATION

As shown in figure 3 the system is connected to local managers to collect the data required for the management of a multivendor set-up. For reasons of safety, the connection between the host machine of the MAN5 system and those containing the local managers must be direct. This means that if the system is physically situated in a network the connection with the host of the local manager of the adjacent network must not use the inter-network connection resources. The administrative information must take a path that is independent of the one followed by the user's data.

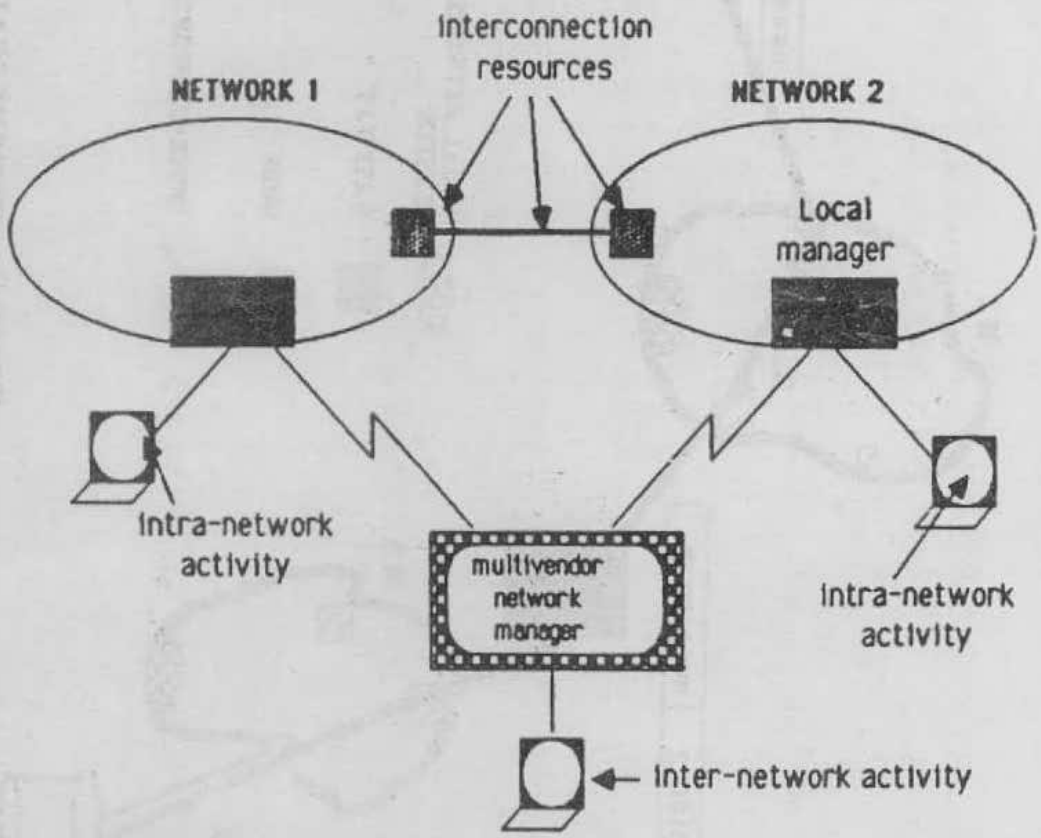

Figure 3 : Position of the multivendor network management system (MAN5)

FUNCTIONAL SPECIFICATIONS

1) MAN5's FUNCTIONS

The MAN5 system is not intended to replace local management but it allows the data coming from the different interconnected networks to be correlated in order to enable the operation to be followed (especially the inter-network sessions), to control the traffic and to bill and detail the costs.

The functions described below were selected for the MAN5 system after analysis of the requirements of two extensive users of multi-vendor networks (CNES and AEROSPATIALE).

In order to fulfil its role of manager of multi-vendor communications systems, MAN5 supplies constantly and in real time, data concerning the operation of the whole system. The data is of several types : visualisation of the inter-network topology of the multi-vendor communications system, alarm and follow-up of the development of any problem, measurement and monitoring of performance (load level as number of packets of interconnection lines and nodes, level of transmission errors, etc.).

From a consultation point of view, MAN5 includes all the dialogue tools required for an operator to obtain information concerning the state or characteristics of node or line, the sessions underway or terminated, various types of performance data, etc.

Access control is a primordial function when information is to be obtained. This function allows the definition of user's profiles and guarantees the security of the information stored in MAN5 system. This is the function which determines whether a given operator has the right to carry out a given operation. Indeed, it seems inconceivable to let anyone do anything they want within the system.

Access control will be obtained by the creation of pass-words which each correspond to a pre-defined privilege (e.g. consultation, configuration and up-dating); the pass-words wil be defined when the system is installed.

A graphic display will play a major role in the representation of management information of the multi-vendor communications system.

Owing to the diversity of the information that MAN5 must supply, related to its management role, a multi-window screen is required.

Most of the data presented on the screen will concern elements of the inter-network domain : network, node, line and session. A local manager knows each of the elements by an identifier which is unique in each "local" network. To avoid any confusion in the designation of the elements : the local identifiers will be displayed.

The MAN5 operator will have, permanently displayed on the screen :

1- A general view of the whole multivendor communications system.

2- A real-time follow-up of the inter-network sessions presenting an anomaly (the anomaly in a session must be correlated to the elements causing it).

3- Performance analysis of the interconnection elements.

By controling the display, the operator can use a window to show :

- All the inter-network sessions and their composition.

- The interconnection topology in the shape of detailed text : this will be displayed after questioning the data-base. The results supplied will show each interconnection group and their composition by displaying the characteristics of the various elements.

- The detailed billing of costs giving the customer the cost of his inter-network session.

- A cost grid helping local operators to choose the most economic route through the interconnected networks (choice between private, public packet and circuit networks).

The other functions the MAN5 system can be called on to perform are :

- Setting up inter-network test sessions which can, in some cases, help in fault finding.

- Establishing a historic record of the information concerning the behaviour of the communications system.

- Adaptation to large scale network environments by setting up a hierarchy of MAN5 systems. Hierarchized management, as advocated by MAN5, is based on the concept of the locality of the sessions in a geographic zone. Two levels of MAN5 systems are required : the first level deals with

intra-network but inter-zone activity whereas the upper level deals with the inter-network activity.

- Progress towards automatic management : automatic and selective return of the information generated by the machine at the different local management systems. The selective nature of the data return is due to the fact that a local manager only has access to information concerning the activities in which its network is involved.

- The possibility of appointing a local manager to replace another when required in the automatic management function of the MAN5 system. After disruption of data flow between the MAN5 system and a local manager, the automatically returned information will be rerouted towards the local management system appointed to replace it.

2) THE MAIN IDEAS

After having seen the different functions of the MAN5 system we should now look at the main guide lines.

- The MAN5 system does not modify the local management systems existing in the networks but uses the work they do to correlate the information coming from the various interconnected networks.

- The application of the MAN5 system works according to an internal standard. The data received from the various local managers will have their syntax and semantics transformed before being treated by the applications.

- The standardization of layers 4, 5, 6 and 7 by ISO is taken into consideration for the internal standardization of MAN5.

- The MAN5 system is not the sum of the various managers of the interconnected networks. It essentially receives data concerning just inter-network sessions, the physical and logical interconnection elements, and also data concerning lethal anomalies occurring in the different networks.

- The MAN5 system only deals with the "macroscopic" treatement of the anomaly processes owing to the work carried out by the local managers. For example, although the address of the node which fails and the characteristics of the inter-network sessions transiting through the node are useful data, the cause of the node anomaly is an intra-network problem (e.g. power supply or memory) and is therfore note within the scope of the MAN5 system.

- The modular conception of the MAN5 system allows, without major modifications, incorporation of a new network, new elements in a network, and new management applications within the MAN5 system.

EXTENSIONS AND DEVELOPMENTS

1) CHANGING ENVIRONMENTS

The environment can change through integration of a network built by a new vendor or integration of new versions of a network (architecture or management).

In the first case a study must be undertaken to develop the local application and define the syntax and semantics file of the management messages.

Integration of a new version of an already existing network would require updating of the syntax and semantic file or extending the internal standard (refining the description of certain elements).

2) EXTENSION OF MAN5

2.1) New functions

In future versions we could imagine the incorporation of new functions such as a dynamic configuration for the topology schematisation, active participation in the management of the whole system and the management of large networks with a hierarchy of MAN5.

The dynamic configuration would consist of the automatic aquisition of the interconnection topology. In the first version of MAN5, which is on development phase, the aquisition is manual.

MAN5, in its first version, plays an informational role for the local operators : all the data prepared are automatically returned to them. In a later version, MAN5 could contribute more directly to decision making by the local operator.

The MAN5 system could also integrate management of large networks. Their administration however cannot be entirely centralized for obvious reasons of the volume of traffic around the central site. Hierarchized management, which MAN5 is capable of, will be based on the concept of the locality of the sessions within a geographical area. Two levels of MAN5

would then be required : the first level would deal with intra-network but inter-zone activity would be concerned with the second one.

2.2) New applications

In addition to the management applications specified in the current version of MANS, further applications could be developed whether by us or by the user. The developments could be made by a programmable interface placed at the user's disposal.

An example of a new application would be the management of users and services. This application would allow groups of users to be defined for billing and access control purposes.

3) INTERGRATION OF THE ISDN

The ISDN (Inegrated Services Data Networks) have today become a reality. In the near future the same equipment will be used to transport data and speech in company communications systems. It will no longer be possible then to continue to manage data and speech separately. A common management system will therefore become necessary. The control criteria for a data session are the statistics of the response times, the flow and rate of errors. Those of a vocal session are rather the statistics concerning the traffic and transmission quality. The integration of voice management can be considered by enlarging the internal standard. In the same way as management messages (session opening, closing, breakdown etc.) describe a data session, messages describing a vocal session (connection of a line, freeing a line, degradation of transmission quality etc.) can also be added.

4) COMPLETE INEGRATION OF THE OSI MODEL

In its present state, the internal standard has been voluntarily limited to the representation of network elements (as a communications system) node, link and session since they are the only ones which we find represented in vendor's standards. As their networks become progressively more standardized we can quite easily imagine the addition of elements such as transport connection and network connection (OSI levels 3 and 4). This would lead to the full integration of the OSI model in the internal standard.

It should be noted that the communication protocols used between MANS's management elements and local applications will be those recommended by ISO when the vendors make them available.

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